

CLAIMS

What is claimed is:

1. An integral heat spreader comprising:
an insert formed of a high thermal conductivity material with a first coefficient of thermal expansion; and
a ring formed of a material with a second coefficient of thermal expansion,
wherein the second coefficient of thermal expansion is smaller than the first coefficient of thermal expansion.
2. The integral heat spreader of claim 1, wherein the high thermal conductivity material comprises copper.
3. The integral heat spreader of claim 1, wherein the high thermal conductivity material comprises aluminum.
4. The integral heat spreader of claim 1, wherein at least 30 percent of the high thermal conductivity material comprises copper.
5. The integral heat spreader of claim 1, wherein the material comprises tungsten.
6. The integral heat spreader of claim 1, wherein the material comprises stainless steel.
7. The integral heat spreader of claim 1, wherein the material comprises invar.
8. The integral heat spreader of claim 1, wherein the material comprises carbon fiber.
9. The integral heat spreader of claim 1, wherein the material comprises a nickel iron alloy.

10. The integral heat spreader of claim 1, wherein the material comprises a material with high elastic modulus.
11. The integral heat spreader of claim 1, wherein the ring includes a stiff material.
12. The integral heat spreader of claim 1, wherein the insert is substantially taper-shaped.
13. The integral heat spreader of claim 1, wherein the volume of the ring is smaller than 25 percent of the volume of the integral heat spreader.
14. The integral heat spreader of claim 1, wherein the volume of the ring is smaller than 50 percent of the volume of the integral heat spreader.
15. The integral heat spreader of claim 1, wherein the volume of the ring is smaller than 85 percent of the volume of the integral heat spreader.
16. The integral heat spreader of claim 1, comprising a plating.
17. The integral heat spreader of claim 1, wherein at least 30 percent of the high thermal conductivity material comprises aluminum.
18. An integral heat spreader comprising:
a first portion including substantially a first material; and
a second portion including substantially a second material,
wherein the first material is a metal,
and wherein the volume of the first portion is smaller than 90 percent of the volume of the integral heat spreader.
19. The integral heat spreader of claim 18, wherein the volume of the first portion is smaller than 70 percent of volume of the integral heat spreader

20. The integral heat spreader of claim 20, wherein the volume of the first portion is smaller than 15 percent of the volume of the integral heat spreader
21. A semiconductor device comprising:
 - a silicon die; and
 - an integral heat spreader comprising:
 - an insert formed of a high thermal conductivity material with a first coefficient of thermal expansion; and
 - a ring formed of a material with a second coefficient of thermal expansion, wherein the second coefficient of thermal expansion is smaller than the first coefficient of thermal expansion.
22. The semiconductor device of claim 21, comprising a thermal interface material.
23. The semiconductor device of claim 22, comprising an underfill.
24. The semiconductor device of claim 23, comprising a substrate.
25. The semiconductor device of claim 24, comprising a sealant.
26. The semiconductor device of claim 25, wherein the semiconductor device comprises a processor.
27. The semiconductor device of claim 21, wherein the ring includes a stiff material.
28. A device comprising:
 - a dynamic random access memory; and
 - a semiconductor device comprising:
 - a silicon die; and
 - an integral heat spreader comprising:

an insert formed of a high thermal conductivity material with a first coefficient of thermal expansion; and
a ring formed of a material with a second coefficient of thermal expansion,
wherein the second coefficient of thermal expansion is smaller than the first coefficient of thermal expansion.

29. The device of claim 28, wherein the semiconductor device comprises a thermal interface material.
30. The device of claim 28, wherein the semiconductor device comprises a substrate.
31. The device of claim 28, wherein the ring includes a stiff material.